# Estimating the Causal Effects of War on Education in Cote d'Ivoire

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Abstract

We estimate the causal effects of armed conflict on years of education in the context of a school-going age cohort in Cote d'Ivoire. Using year and department of birth to identify an individual's exposure to war, the difference-in-difference outcomes indicate that the average years of education for a school-going age cohort is .94 years fewer compared to an older cohort in war-affected regions. We further use a set of victimization indicators to identify the effect of war. Overall, the findings across different models suggest a drop in average years of education by a range of .2 to .9 fewer years.

Keywords: War, Human capital, Education, Propensity score matching, evaluation, Africa

JEL Classification: I20, J13, C40, H43, O15

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## I. Introduction

Conflict affects education in several ways. It destroys infrastructure (Abdi, 1998), displaces and most tragically results in the deaths of students and teachers (Buckland, 2005), causes problems in harmonizing school calendars across war-affected regions (UNICEF, 2005) while schools remain closed for an indefinite period of time (Bruck, 1997), and has a damaging and pernicious socio-psychological impact on students (Sany, 2010). A cross-country analysis by Lai and Thyne (2007) shows that countries experiencing civil war suffer a decline in school enrolment by 1.6 to 3.2 percentage points. Evidence is growing at the subnational level that the outcomes are similar. Merrouche (2006) documents that an exposure to landmines in Cambodia resulted in an average loss of .4 years of education. In a similar study, the mid-1990s genocide in Rwanda lowered the average level of educational attainment by .5 years (Akresh and de Walque, 2008). From the perspective of gender, Shemyakina (2006) finds that conflict makes no significant impact on male education rates in Tajikistan. However, females were 12.3 percentage points less likely to complete the mandatory secondary schooling compared to those who completed their education before the war broke out. A recent study, using household survey data between 2000 and 2008 from twenty-five conflict affected countries, finds that conflict leaves a legacy of fewer average years of education, decreased literacy rates and a smaller share of the population with formal schooling (UNESCO, 2010).

In this paper we estimate the average causal effect of conflict on education in Cote d'Ivoire. In particular, we measure the effect of Ivoirian conflict, which reached its peak between 2002 and 2004, on years of education for individuals who were exposed to it in their school-going age. The civil war in Cote d'Ivoire broke out in September 2002 as a result of growing ethnic tensions and a failed attempted military coup. It divided the country into two: the rebel-held North and the government-controlled South and caused more than 3,000 deaths (World Bank, 2010). The war internally displaced more than 700,000 people and as many as 500,000 children were out of school between 2002 and 2004 (UNICEF, 2004). According to the Ministry of Education in Cote d'Ivoire (2004), education in the North was affected more severely than education in the South. As per this report, almost 50 percent of the school-going aged children were out of school and only 20 percent of government-paid teachers stayed in their posts in the

North since 2002. Moreover, the start of the 2005 school year was delayed in the North, and approximately 72,000 children were unable to write their examinations in the North (UNICEF, 2005).

A recent study by UNESCO (2010) uses 2006 Multiple Indicator Cluster Survey (MICS) to conduct a quantitative study on the relationship between education and war in Cote d'Ivoire. This study finds an increase in the uneducated proportion of male cohorts in war-affected areas. Looking separately at the educational attainments for males and females, it concludes that for both genders the average educational attainment has dropped since the conflict broke out. To our knowledge this is the only quantitative study so far that examined the impact of war on education in Cote d'Ivoire. However, this study does not draw any causal inference on the potential impact of war on education. In addition, the MICS survey was undertaken in 2006 just after conflict had reached its peak, and as a result it might not have demonstrated the full impact of war.

Our study aims to bridge this knowledge gap. We calculate the average causal effect of civil war on education in Cote d'Ivoire using the Households Living Standards Survey (HLSS) data collected in 2008 and the data on local incidences of conflict is taken from the Armed Conflict Location and Event Database (ACLED). Our baseline empirical strategy to identify the indirect effect of war on education for the school-going age-cohort uses year and department of birth to determine an individual's exposure to war. Using the variation in conflict intensity across departments, this strategy identifies the effect of conflict victimization indirectly. We also use a set of victimization indicators to measure the direct effect of war. The difference-in-difference regression outcomes indicate that the average years of education for individuals aged 10 to 22 is .94 years fewer compared to the individuals aged 23 to 32 in war-affected regions.

As a robustness check, we use the same set of victimization indicators to measure the potential effect of war and estimate a counterfactual comparison group based on propensity scores matching. This, we expect, is likely to minimize the selection bias and confounding in the causal effect. The average causal effect of war identified by all the victimization categories indicates .2 to .9 fewer average years of education for war victims compared to the matched control group. The outcomes of double-robust models satisfactorily show less chances of misspecification in the estimated models. The outcomes are robust when we use a number of sensitivity analyses including alternative matching methods, estimating the North and the South

subsamples separately. In addition, we estimate the direct effect of conflict exposure across gender and age-specific groups. The outcomes are robust and show the largest impact on boys and individual in the age group 19 to 22.

The paper is structured as follows. In section II, we provide a brief outline of the nexus between education, politics and war in Cote d'Ivoire. Section III describes the data and provides some descriptive evidence. We discuss the empirical models, identification strategies and the empirical findings in section 4. This is followed by the outcomes of sensitivity analysis in section 5. We provide our concluding remarks at the end.

## II. The Political Economy of War and Education

To evaluate the impact of conflict on education in Cote d'Ivoire, it is important to understand the Ivoirian education system and how it was linked to the consequences of armed conflict. First we provide a brief account of the war and education nexus in Cote d'Ivoire for the period until the war broke out. We then discuss it for the period 2002 to 2006, during and after the conflict peak.

### 2.1 The period until 2002

Since its independence in 1960, the education system has been central to Ivoirian identity and politics. Cote d'Ivoire follows the centralized French education system, where the government plays a key role in curriculum development, coordination and allocation of resources and the organization of national examinations through the ministries of Education, Vocational Education and Higher Education. Prior to the civil war the education system was already struggling with a student-teacher ratio close to 40 (UNAIDS, 1998) while the net enrollment rate in primary education recorded around 60 percent (Cote d'Ivoire Ministry of Education, 2003). In 2000, following the Education for All (EFA) initiative - a worldwide plan to meet the learning outcomes of all children, youth, and adults by 2015 - a number of educational reforms were initiated by the newly elected President Laurent Gbagbo. The proposed agenda addressed areas that needed much attention including improvement of the status of teachers, enactment of the free public schooling through tenth grade and a nationwide preschool system. Perhaps because of

this the net national enrollment rate in primary education slightly improved to 64.2 percent in 2001 (Cote d'Ivoire Ministry of Education, 2003).

While economic disparity between the North and the South and polarization of ethnicity and identity based on national origin were arguably the main causes of Ivoirian civil war, unequal access to education and uneven allocation of educational infrastructures between the North and the South also played a crucial role (Sany, 2010). Despite the improvement in country-wide net enrollment rates in the early 2000s, the enrollment rate in the Northern states of Korhogo and Odiene were below 40 percent. Overall, there was a marked disparity in enrollment rates between the Northern states (less than or equal to 50 percent) and the Southern states (close to 80 percent).

### 2.2 The period from 2002 to 2004

The first phase of armed conflict started in September, 2002 but lasted for only a few months. The national army (FANCI) was joined by the Young Patriots, a youth militia that supported then President Gbagbo. On the other side, the rebel groups - the *Movement for Justice and Peace* (MJP), the *Movement of the Ivory Coast of the Great West* (MPIGO) and supporters of Alessane Outarra (current President) - joined forces under the banner of the *Forces Nouvelles* (FN) led by Guillame Soro. The momentum of educational reform initiated in 2000 was soon arrested by the outbreak of civil war. As the conflict broke out, education moved to the bottom of the national priority list (Sany, 2010). A UNICEF estimation in 2005 accounted for as many as 700,000 children being out of school between 2002 and 2004. This figure included students from primary school to university level. In November 2004, riots against the French force in Abidjan destroyed infrastructure including numerous schools buildings there (UNICEF, 2005). In 2004, the Cote d'Ivoire Ministry of Education documented more than 50 percent of the students in the North did not have any access to school.

As argued by Sany (2010) education was used by both parties as a tactic of war. Due to war the organizational and institutional challenges in delivering the basic educational facilities were less in the government-held South compared to the rebel held-North. The Government side used this as a strategy to portray the inability of non-governmental forces in providing basic

education and necessary infrastructure. Perhaps it paved a way for the government to legitimize its position, but it forced the non-governmental opposition to come up with an alternative strategy. An UNOCHA (2004) report found that there were more than 300,000 children in the North attending NGO-run primary and secondary schools from 2002 to 2004. The success of the NGOs in delivering education in the North indicates that the disparity in the provision of educational facility had more to do with the agendas of the political parties in conflict than to the fear of violence and lack of security (Sany, 2010). Validation of previous examination results in the rebel-held North and harmonization of the school calendars between the North and the South – later became part of the peace agreements signed by the parties in conflict.

In addition, since the early 1990s the teacher's struggle to regain their lost status due to Structural Adjustment Program became an alarming issue especially for the political parties in power. As Sany (2010) remarks the struggle within the education sector has also facilitated the escalation of the conflict from the university campus into the political sphere. During the conflict both sides actively sought to include university students on their side. The higher education institutes filled with active students' organizations and teachers' associations became the center stage of political movements. Many prominent political leaders including the former President Laurent Gbagbo and former Prime Minister Guillaume Soro emerged from the students' movements, reinforcing the Ivoirian sentiment that the education system has produced political leaders rather than business leaders (Sany, 2010).

## III. Data and Descriptive Evidence

[Figure 3.1 is about here]

In this study we use two main data sources. The data on local incidences of conflict is taken from the Armed Conflict Location and Event Database (ACLED). The Armed Conflict Location and Event Database[i] (ACLED) (Raleigh, Hegre, and Carlson, 2009) compiles exact locations, dates, and additional characteristics of individual battle events in states affected by civil war. The conflict data for Cote d'Ivoire is available for the period from 1997 to 2010. The ACLED

database on Cote d'Ivoire reports a total number of 965 conflict events between 1998 and 2008. It tracks rebel activity and distinguishes between territorial transfers of military control from governments to rebel groups and vice versa. The conflict events are disaggregated into six categories: (i) Battle - government regains territory, (ii) Battle - no change of territory, (iii) Battles - rebels overtake territory, (iv) Non-violent activity by a conflict actor, (v) riots/protests, and (vi) Violence against civilians. In Figure 3.1, we show the total number of reported conflicts per year for the period starting from 2001 to 2006. The conflict intensity reached its peak between 2002 and 2004 with a total of 459 conflict events.

For empirical purposes, we disaggregate the conflict events into 50 departments, which are nested into 19 regions in Cote d'Ivoire. To decipher the causes and consequences of conflict at the local level, many studies have used smaller geographical regions or artificial geographic grid-cells (without pertaining to any meaningful sub-national border) as the unit of analysis. Some researchers prefer to follow the grid-cell approach because the unit of analysis does not change spatially (Buhaug and Rod, 2006). In comparison, when the unit of analysis is the sub-national regions, they are likely to vary in terms of area. In this study we map the exact locations of the conflict event provided by the ACLED database into 50 departments using spatial coordinates taken from the DIVA-GIS[ii] website.

[Figure 3.2 is about here]

Figure 3.2 plots the total number of conflict events at the department level for the period 2002 to 2004. On the left hand panel of Figure 3.2, we show the conflict prevalence map taken from the ACLED website[iii]. On the right hand panel, we plot the intensity of conflict across departments. The geographical areas marked with darker shades indicate departments that experienced more intense conflict. The incidences of civil conflict have been more frequent in the western and southern departments of Core d'Ivoire and in the neighborhood of Abidjan. Between 2001 and 2006, the average number of conflict events per department recorded at 8.6. In 2003, only in Abidjan the number of armed conflict events escalated to more than 150. Furthermore the conflict events occurred at a large number near the Line of Control administered

by UN and French troops. About three-quarters (37 out of 50) of the departments experienced at least one conflict event during the period from 2002 to 2006.

[Figure 3.3 is about here]

We use the 2008 round of Households Living Standards Survey (HLSS) data, also known as *Enquete sur le Niveau de Vie de Menage* (ENV). These surveys were undertaken by the National Institute of Statistics in Cote D'Ivoire. The ENV-2008, jointly administered by the National Institute of Statistics - Cote d'Ivoire and UNICEF, was specifically designed to document the consequences of the civil war. A new section on the 'impact of the war' was added, which included a range of questions that are commonly used to evaluate the welfare impact of war on individuals and households. For example, household respondents were asked: "How did your income change over the years of crisis?" and "Has the current crisis affected your life?" In addition, the survey included a set of questions on the physical impact and casualty of the war, such as "Have you registered a death or illness linked to the crisis?", "Have you been displaced during the war?" and "Have you suffered any violence linked to the crisis?"

In Figure 3.3 we provide a pictorial view of the war victimization based on household responses. We plot the average responses at the department level; darker shades imply a higher average rate of victimization experience for the inhabitants in a department. It is evident that the civil war had an adverse effect on the livelihood of the entire population in Cote d'Ivoire; however the impact was more prevalent in the Middle and the Northwest of the country. Overall, between 30 to 50 percent of the respondents experienced declines in their income. The incidence of war victimization was more prominent in the departments located near the UN-peace keeping line and to the West where the civil war was more intense. Nearly 30 percent of the respondents had to hide during the war in the Northwestern departments. The conflict in the mid-West of the country is also marked by high levels of internal displacement. The adverse effect of the war on jobs and land is prevalent throughout the country. However, the people in the mid-West reported to have experienced loss of livestock and non-land assets.

Next, we turn to the education system in Cote d'Ivoire. The *Certificat d'etude primaries elementaires* (CEPE) is awarded after completing six years of primary education, which is followed by seven years of secondary schooling. In the final year of secondary school students earn a baccalaureate degree. Universities, technical and vocational trainings are part of the higher education system in Cote d'Ivoire (Sany, 2010). As is evident from the ENV-2008 data, in the sub-population consisting of individuals aged 12 and above, about 35 percent earned a CEPE whereas only 10 percent completed the baccalaureate degree. However, almost 40 percent from the same group of people did not complete the CEPE. The average years of education stands a little above 7 years, which is one additional year of education after six years of primary education (CEPE). Based on this anecdotal evidence, it could be the case that the age-cohort of primary school goers are likely to be one of the potential victims of war. In this study, we use years of education as the main outcome variable to evaluate the causal effects of war on education in Cote d'Ivoire.

In Table 3.1 we provide descriptive evidence of basic indicators on conflict affected individuals. The first two columns compare the average outcomes for a young cohort (10 to 22 years old) between the low conflict and the high conflict departments, the last two columns show the same for an older cohort (22 to 32 years old). We define high conflict as departments experiencing at least one conflict event in the period 2002-2006, if there is no evidence of reported event of conflict we call it a low conflict area. As is evident from table 3.1, the average years of education are lower for the young cohort, though the education attainment gap is insignificant between high and low conflict areas. Other educational variables do not show any significantly different outcomes for war affected individuals. We use log of per capita household consumption expenditure as an indicator of household welfare. We consider ten expenditure categories including food, education, health, transport, clothing, and transport among others to construct this indicator. The gap in the average welfare level is negligible between the high and the low conflict areas. While average years of education is higher for the old cohort, a higher percentage of households are female headed in the conflict affected areas. Among the ethnic groups, Akans are in large numbers in high conflict areas whereas members of the Voltaic group concentrate more in the low conflict areas. Overall, these preliminary summary statistics are suggestive of a lower educational attainment for children in the conflict affected regions, in the

next section we use both the direct and indirect exposure to conflict to evaluate its effect on educational.

## IV. Empirical Outcomes

### 4.1. Indirect exposure to conflict: Identification using department and year of birth

According to the ENV-2008 survey data, for more than 90 percent of the individuals who earned the CEPE (completed six years of primary education), it took between 6 to 10 years. This suggests the majority of the students in the primary school are in the 6 to 16 age group with the plausible assumption that primary education normally starts at the age of six. To identify the potential victims of war, we construct a young cohort including all primary school goers who were exposed to the conflict between 2002 and 2006. Based on this, the individuals aged between 10 and 22 years constitute the young cohort in the ENV-2008 survey. Using ENV-2008, we compare average years of education for individuals in the young cohort against an older cohort, aged between 23 and 32. The individuals in the old cohort are likely to be over the age of primary school goers between 2002 and 2006. We use the year of birth and the department of birth to identify an individual's exposure to war. To begin with, a straight forward difference-in-difference of average years of education is calculated based on year and department of birth.

[Table 4.1.1 is about here]

Table 4.1.1 reports average years of education for both age-cohorts and a war prevalence dummy, which takes the value of one if a department (of birth) experienced at least one conflict event, zero otherwise. The war prevalence of a department reflects the total number of conflict events between 2002 and 2006. For both age-cohorts, the average years of education in conflict-affected departments is higher compared to the rest. However, the gap in average years of education is negligible for the young cohort. Two possible explanations can be offered. First, the war zones (departments that experienced conflict) traditionally had higher average years of education and this could be due to better educational facilities or better job prospects. Second,

due to the pernicious effect of conflict throughout the country, the gap in average years of education between war and non-war zones became smaller for the young age-cohort. This is supported by the evidence that the gap in average years of education between older and younger cohort is twice as big in the war zones compared to the departments with no war event. Overall, the difference-in-difference outcome suggests that an individual aged between 10 and 22 experienced an average drop of 1.2 years of education if resided in a war affected department.

We generalize this identification strategy with a regression framework, shown as equation 1 (Duflo, 2001; Merrouche, 2011; Shemyakina, 2011). This estimates the average years of education as a function of birth fixed effects and household / individual specific controls. If exposure to conflict (i.e. residing in the departments that had at least one conflict event) is detrimental to years of schooling, then the estimated coefficient of average years of education will be negatively related to the intensity of war for the young age-cohort which is exposed to conflict.

**(1)** $$y_{ijk} = C_1 + Depart_{1j} + Birth_{1k} + (War_j \times Treat_i)\beta_1 + (X_i)\delta_1 + \varepsilon_{ijk}$$

where $y_{ijk}$ measures years of education for an individual *i* born in department *j* in year *k*. $C_1$ is a constant, $Depart_{1j}$ is a dummy variable indicating department of birth fixed effect, $Birth_{1k}$ is a dummy variable that measures cohort of birth fixed effect, $Treat_i$ is a dummy variable indicating whether the individual belongs to the young cohort, $War_j$ is a variable measuring intensity of conflict and $X_i$ is a vector of household specific controls.

Table 4.1.2 presents estimates of equation (1). The first two columns show the baseline regression outcomes when the war intensity variable is a dummy, takes a value of one if a department had at least one war event, zero otherwise. The baseline regression model without household controls yields a coefficient of -.94. This suggests average years of education for individuals aged 10 to 22 is .94 years fewer compared to the individuals aged 23 to 32 in departments that had at least one conflict event. The coefficient drops to -.5 when we include

household level control variables (as shown in column 2). If there is significant variation in the conflict count across departments, the dummy conflict indicator may not adequately explain the variation in average years of education across departments. As a robustness check, the next two columns report the estimated coefficients of years of education when the war intensity variable is measured as the actual number of conflict events. The outcome suggests that an increase in the war intensity by one additional event of conflict lowers the average years of education for the young age-cohort (aged 10 to 22 years) by .01 years compared to old age-cohort (aged 23 to 32).

[Table 4.1.2 is about here]

For difference-in-difference to be a valid strategy, the assumption of common trends before the conflict periods needs to be verified. In order to check this, we compare educational outcomes of individuals aged 23 to 32 against individuals aged 33 to 42 years old. Presumably, individuals in both age cohorts were in school-going age before the conflict took place. The last two columns of table 4.1.2 show the estimated coefficients. The statistically insignificant difference-in-difference coefficient suggests that it less likely that the localization of conflict is endogenous with years of education and pre-existing factors such as the education has exacerbated the conflict. Overall, the outcomes in table 4.1.2 suggest that indirect exposure to conflict has a detrimental effect on years of education.

### 4.2 Direct exposure to conflict: Identification using victimization indicators

The estimated coefficients of the causal effect of war on education show an expected sign. However, it can be plagued by a number of issues. First, using department of birth as an identification strategy may not reveal the heterogeneous impact of war victimization on education for children from different socio-economic groups. In other words, there exists a possibility of selection into victimization across individuals which could be largely hidden by the total number of conflict events in a department. Second, the proximity to a war zone dummy variable may fail to identify the true impact of war on education because the intensity of war

measured as the count of war events varies significantly across departments. Third, due to a large number of internally displaced people, it is often hard to track their movements between 2004 and 2008. It is also possible that the household control variables for the comparison group might have changed over time, especially if they migrate. As a result, we harbor on an alternative identification strategy to measure the direct exposure to conflict.

As a next step, we use 11 victimization indicators as potential identifiers of true war victims. The victimization indicators are dummy variables, which takes the value of one for a household or individual being a victim, zero otherwise. It is possible that the self-reported victimization indicators may produce subjective bias related to a particular ethnic group or other identities. The simplest way to detect the extent of this bias is to estimate each victimization indicator as a function of the observable characteristics. The estimated outcome does not conform to any subjective bias generated by any particular variable (for reasons of space we do not show the outcome in the paper; it is available from the authors if requested).

We first estimate the standard linear OLS regression outcomes of years of education as a function of the victimization dummy and household and individual controls on a sample restricted to individuals aged between 10 and 22 (who are likely to be in the primary school during the conflict). In Table 4.2.1 we report the estimated coefficients for the eleven victimization categories (columns M1 through M11). The coefficients of all the victimization dummy variables are negative. The coefficients are statistically significant for victimized individuals or households when they registered deaths or injuries due to conflict , income dropped, lost job, lost livestock and experienced violence due to war. Overall, the estimated war outcomes on education are in line with previous findings, despite the fact that the impact of war is now identified by a set of victimization indicators based on the subjective evaluation of war impact by the survey respondents.

[Table 4.2.1 is about here]

## V. Sensitivity analysis

### 5.1. Propensity score matching outcomes

The identification strategies used so far assume that the war victims (as identified above) and control groups are exchangeable, such that they have identical distributions of variables. This can be confirmed by data using a randomized controlled trial; however, drawing causal inference using survey data requires a more careful analysis because selection biases and confounding invalidates the exchangeability assumption. In such cases the estimated causal effects are likely to be biased. Since a direct comparison of two groups of individuals may not overcome the problem of identification, we go one step further and employ propensity score matching (Rosenbaum and Rubin, 1983). This means pairing individuals who are identical based on all observable characteristics (including department of birth, other households characteristics and the relevant socio-economic factors) that the rich ENV-2008 survey data offers, except variables that measure war victimization. We discuss it more formally in the online appendix.

There exists a range of possibilities for matching algorithms; however, the performance of different matching estimators depends largely on the data structure (Zhao, 2000). For our purpose, we use the straightforward nearest neighbor matching as a baseline strategy. This method first categorized both the treatment and the control group records according to the estimated propensity score and then searches backward and forward for the closest control units for a particular treatment value. Overall, most of our empirical models do not encounter any common support problem (discussed in detail in the online appendix). Table 5.1 summarizes the estimated effect of war on educational outcomes for each of the 11 models. The propensity score matching method yields a negative impact of conflict on years of education in the sample restricted to individuals aged between 10 and 22. The average treatment effect on the treated (ATT) indicates that irrespective of the type of war victimization, war victims in comparison with the matched control group indicate a lower average years of education. The mean difference is significant particularly when the war victims registered for deaths due to the war, their income dropped, they lost jobs and they reported being affected by the war.

[Table 5.1 is about here]

As a further robustness check we use the concept of double-robust estimators (Robins, 2000; Bang and Robins, 2005). The double-robust estimation method requires a model for estimating the propensity scores and the outcome model (OLS in our case) in the same estimator (discussed in detail in the online appendix). Overall, the findings show mixed outcomes, and there exists a trade-off in the estimation model choice between the OLS and propensity scores matching. We also employ additional matching criteria such as the *nearest neighbor matching without replacement*, the *caliper matching*, and the *kernel matching*. The findings (shown in the online appendix) reveal that the causal effect of war on education is negative throughout and this outcome is independent of any matching criterion.

### 5.2. Alternative measures of educational outcomes

In the previous analysis we used only total years of education as an educational outcome variable. As a sensitivity analysis, we propose to look at another potential outcome variable that measures the percentage of population that completed CEPE (six years of primary education). This is justified by the fact that the average years of education based on the ENV-2008 data is recorded as being little over 7 years and almost 40 percent of the population fail to complete the CEPE. Thus, percent completed CEPE can be a good indicator the status of education in Cote d'Ivoire. We estimate nonparametric kernel-weighted local polynomial regressions of percent ever completing six years of primary education against age using Epanechnikov kernel. We ran the regressions separately for the war victims and the rest of the sample as identified by the victimization indicators. The internally displaced individuals do not show a different trend in the successful completion of CEPE; however, from households that suffered from ownership loss, indicate a drop in the rate of successful completion of six years of primary education.

### 5.3. Effect of direct exposure to war on sub-samples: The North versus the South

We compare empirical outcomes from sub-samples: the North and the South. We designate the departments using the United Nations peace-keeping line (also known as the fault line). Out of a total of 50 departments, the North has 16 and the rest of the departments are classified as being in the South. We find that for both the old and the young cohort, the average years of education is lower in the North (The tables are shown in online appendix III). The difference-in-difference outcome implies individuals in the young-age cohort have on average .72 more years of education compared to the old cohort in the North. This is somewhat in contradiction with the anecdotal evidence that the North was hit harder due to conflict. To obtain a generalized picture, we run OLS regression outcomes. The impact of conflict on the average years of education by regions (the North and the South) is identified by the victimization indicators with the same set of control variables. Overall, the findings do not suggest any clear evidence in support of the North being the worst war-affected region in terms of education outcomes.

### 5.4. Effect of direct exposure to war on sub-samples: Gender and age-specific groups

Table 5.4 reports outcomes of direct exposure to conflict on years of education for females, males and other subgroups comprising of individuals aged 10 to 14, 15 to 18, 19 to 22 years old. On average, male respondents who are direct victims of conflict have less number of years of education. Female respondents report negative outcomes however the magnitude of the effect of conflict is lower and less significant statistically. When compared across different age groups, for individuals in the age group 19-22 who are directly exposed to conflict show a larger drop in years of education, in some cases about 2 years. Individuals in this age group, whose family members experienced a job loss or a drop in income due to conflict experienced the largest drop in years of education. This could be because they joined the labor force to help support their families. Overall, direct exposure to conflict affects years of education negatively, the outcomes are robust.

## VI. Conclusion

The relationship between education and war in Cote d'Ivoire is complex. While anecdotal evidence from various reports and studies suggest that education has been a clear victim of war, the education system in the North has been a victim of Ivoirian politics since the early 1990s and the North-South divide following the civil war only exacerbated that ongoing crisis. This makes

the task of finding a causal inference of the war on education particularly challenging. In this paper we estimate the causal effect of civil war on years of education for individuals who were exposed to conflict between 2002 and 2006 in their school-going age. We use the Households Living Standards Survey (HLSS) data collected in 2008 (ENV-2008) and the data on local incidences of conflict is taken from the Armed Conflict Location and Event Database (ACLED) for the empirical analysis.

We employed empirical strategies to identify both direct and indirect exposure to conflict for individuals in their school going age. We use the year of birth and the department of birth to determine an individual's indirect exposure to war. The difference-in-difference outcomes indicate that the average years of education for individuals aged 10 to 22 is .94 years fewer compared to the individuals aged 23 to 32 in war-affected regions. The validity of the finding is tested by a number of factors such as common support before the break-out of conflict, heterogeneous selection into victimization both across and within a region and varying intensity of conflict across regions. The direct impacts include destruction of infrastructure, displacement and most tragically deaths of students and teachers, problems in harmonization of school calendars across the war-affected regions and closure of schools for an indefinite period. Other effects such as loss of jobs and farm, decrease in income and experiencing violence could also affect the education of children in the same household. To realize the full potential impact of war, we used a set of victimization indicators to identify the direct impact of the war. The fixed effect OLS models conform to the negative impact of conflict on education outcomes.

We use a number of tests to check the validity of the estimated outcomes. We used propensity scores matching to minimize the selection bias and confounding in the causal effect. The average effect of war as identified by the victimization categories reports a .2 to .9 fewer average years of education for the war victims in comparison to the matched control group. The moderately satisfactory outcomes of double-robust models lower chances of misspecification in the estimated models. The outcomes are also robust when we use alternative matching methods, using different educational outcome variables and estimating the North and the South subsamples separately. We also looked at subsamples by gender and different age-groups. For individuals in the age group 19-22, the estimated outcomes show the largest impact of conflict on

years of education; males on average have less years of education compared to females when directly exposed to conflict.

Understanding the mechanism though which war affects education is critical in order to disentangle the causal effects of war on education. The education and war nexus in Cote d'Ivoire provides a complex picture and in this paper we attempted to explore the channels through which war could possibly affect education. Nevertheless, some caveats apply. The role of third parties, such as NGOs in promoting primary and secondary education in the North is difficult to measure in the estimated causal effect. It is also possible that the existence of internally displaced populations and the timing of the survey could downplay the estimated causal effect. Nevertheless, the empirical evidence derived from our study on Cote d'Ivoire provides robust support to the existing studies on how war has a detrimental impact on education.

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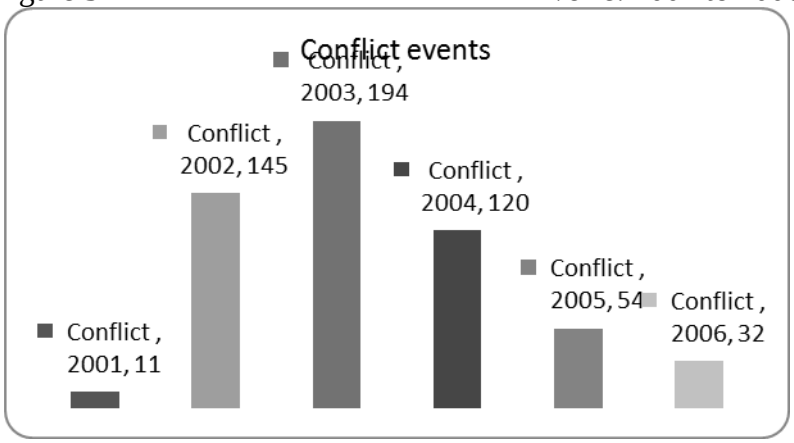
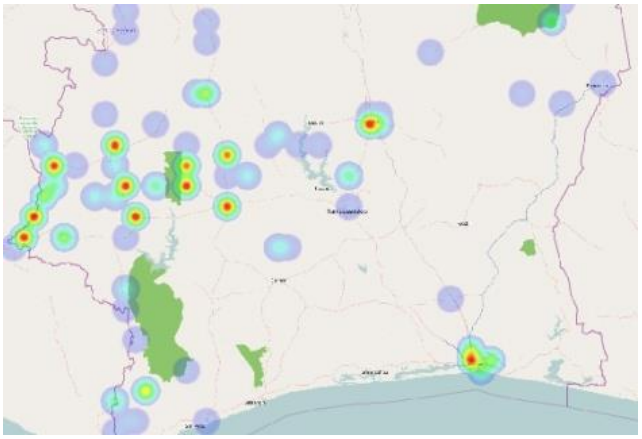
Figure 3.1 Incidence of Conflict in Cote d'Ivoire: 2001 to 2006



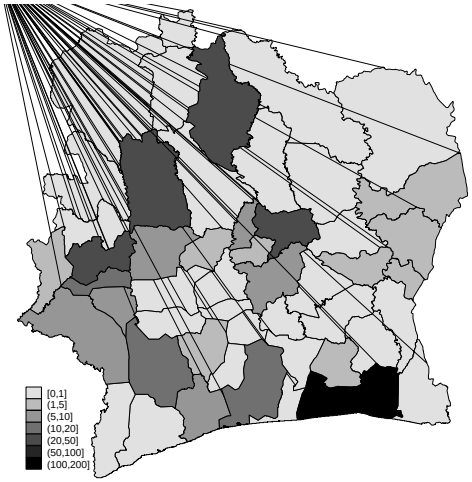

Source: Authors' calculation based on the ACLED database

Figure 3.2 Conflict events map at the department level: 2001 to 2006

Conflict events map from ACLED

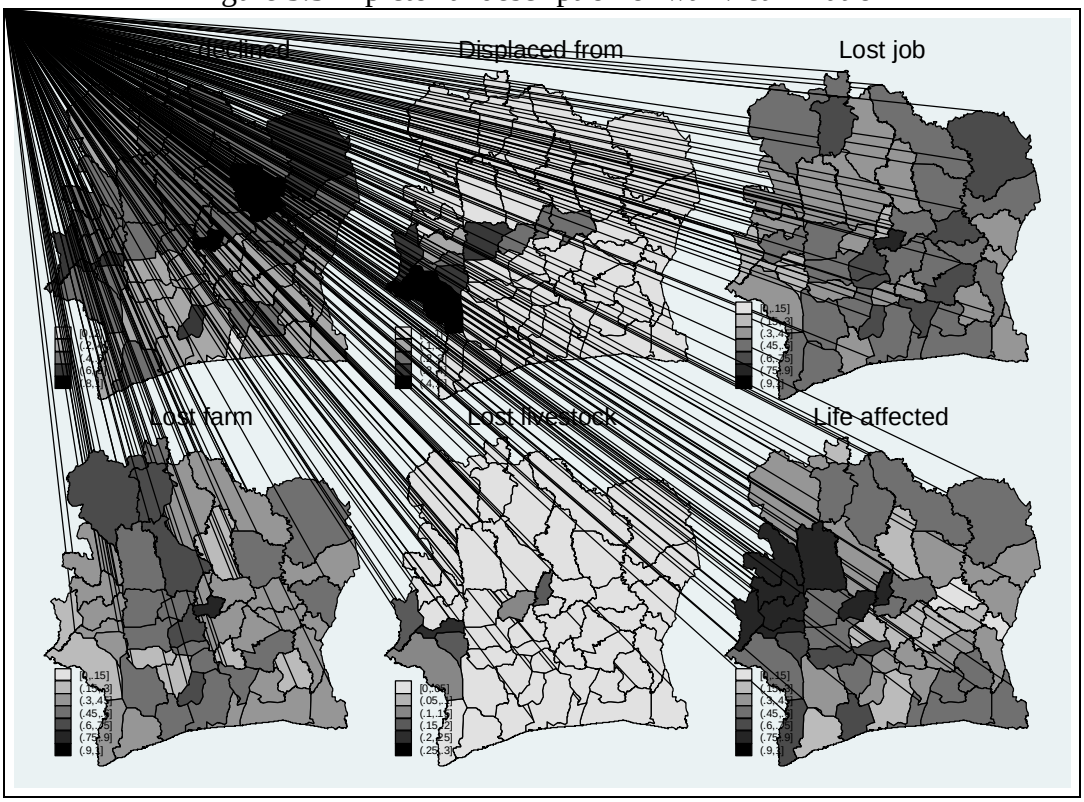


Conflict Events: Department level




Source: ACLED and authors' own calculations

Figure 3.3 A pictorial description of war victimization




Source: ACLED and authors' own calculations based on the 2008 round of *Enquete sur le Niveau de Vie de Menage* (ENV).

Table 3.1 Descriptive evidence

| | Young cohort (Age 10 to 22) | | Old cohort (Age 23 to 32) | |
|---|---|---|---|---|
| | Low conflict | High conflict | Low conflict | High conflict |
| Average years of education | 6.30 | 6.46 | 7.75 | 9.17 |
| Completed primary education | 0.33 | 0.32 | 0.30 | 0.28 |
| Registered in school | 0.73 | 0.72 | 0.09 | 0.12 |
| Log of per capita consumption expenditure | 11.34 | 11.53 | 11.55 | 11.83 |
| Female | 0.40 | 0.45 | 0.39 | 0.43 |
| Household head is female | 0.16 | 0.21 | 0.16 | 0.19 |
| Number of children below 5 years old | 0.85 | 0.82 | 0.87 | 0.76 |
| Number of children 5 to 9 years old | 1.00 | 0.94 | 0.68 | 0.63 |
| Number of children 10 to 14 years old | 1.15 | 1.15 | 0.46 | 0.47 |
| Average years of education ( excluding children) | 4.08 | 4.41 | 4.72 | 5.83 |
| Ethnic group: Akan | 0.25 | 0.36 | 0.26 | 0.37 |
| Ethnic group: Krou | 0.17 | 0.15 | 0.20 | 0.17 |
| Ethnic group: Mande North | 0.13 | 0.14 | 0.10 | 0.13 |
| Ethnic group: Mande South | 0.08 | 0.09 | 0.09 | 0.08 |
| Ethnic group: Voltaic | 0.19 | 0.10 | 0.16 | 0.10 |
| Religion: Muslim | 0.34 | 0.32 | 0.31 | 0.31 |
| Religion: Christian | 0.44 | 0.48 | 0.49 | 0.52 |

Source: Authors' own calculations based on the 2008 round of *Enquete sur le Niveau de Vie de Menage* (ENV). High conflict areas include departments that experienced at least one event of conflict during the period from 2002 and 2006. Low conflict areas include department that did not experience any events related to conflict in the same period.

Table 4.1.1 Means of Years of Education by Cohort and War Prevalence

| | Years of education | | |
|---|---|---|---|
| | No War | War | Difference |
| Old Cohort (Aged 23 to 32 in 2008) | 7.84 | 9.18 | -1.34 |
| | (0.14) | (0.08) | (0.18) |
| Young cohort (Aged 10 to 22 in 2008) | 6.32 | 6.46 | -0.14 |
| | (0.06) | (0.04) | (0.07) |
| Difference | 1.52 | 2.71 | -1.20 |
| | (0.13) | (0.08) | (0.16) |

Note: Standard errors are in parenthesis, all estimated coefficients are statistically significant at 1 percent

Table 4.1.2 Effect of War on Education using 2008 household survey data
(Dependent variable = Years of Education)

| | **War intensity = dummy (=1 if there was at least one war event)** | | **War intensity = actual number of conflict events** | | **War intensity = dummy (=1 if there was at least one war event)** | **War intensity = actual number of conflict events** |
|---|---|---|---|---|---|---|
| War intensity × Cohort dummy (ages 10 to 22 = 1; ages 23 to 32 = 0) | -0.940*** | -0.499*** | -0.011*** | -0.008*** | | |
| War intensity × Cohort dummy (ages 23-32 = 1; ages 33 to 42 = 0) | | | | | -0.123 | -0.001 |
| Control variables | | | | | | |
| Birth fixed effects (department) | Yes | Yes | Yes | Yes | Yes | Yes |
| Birth fixed effects (Age Cohort) | Yes | Yes | Yes | Yes | Yes | Yes |
| Household controls | No | Yes | No | Yes | Yes | Yes |
| Constant | 8.355*** | 4.677*** | 8.477*** | 4.651*** | 1.135 | 1.173 |
| Observations | 16,345 | 16,017 | 16,345 | 16,017 | 8,161 | 8,161 |
| R squared | 0.235 | 0.423 | 0.241 | 0.426 | 0.342 | 0.342 |

Notes: The household level controls include log per capita consumption expenditure, gender, gender of household head, average years of education in the household, ethnic groups (Akan, Krou, Mande North, Mande South, Voltaic (comparison group) and religious groups (Muslims and Christians); *** implies significant at 1%, ** implies significant at 5% and * implies significant at 10%. Estimation with robust standard errors.

Table 4.2.1 OLS Regression outcomes on Average Years of Education for individuals aged 10 to 22

| | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Registered deaths | -0.128** | | | | | | | | | | |
| Registered injury | | -0.115* | | | | | | | | | |
| Displaced | | | -0.033 | | | | | | | | |
| Income dropped | | | | -0.220*** | | | | | | | |
| Lost ownership | | | | | -0.125 | | | | | | |
| Lost job | | | | | | -1.602*** | | | | | |
| Lost farm | | | | | | | -0.516 | | | | |
| Lost livestock | | | | | | | | -0.682*** | | | |
| Lost assets | | | | | | | | | -0.200 | | |
| Affected by the war | | | | | | | | | | -0.058 | |
| Experienced violence | | | | | | | | | | | -0.240*** |
| Control variables | | | | | | | | | | | |
| Birth fixed effects (department) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Birth fixed effects (Age Cohort) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Household controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 6.152*** | 6.076*** | 6.185*** | 6.213*** | 6.181*** | 6.115*** | 6.192*** | 6.168*** | 6.190*** | 6.235*** | 6.172*** |
| Observations | 10,552 | 10,331 | 10,492 | 10,625 | 10,625 | 10,625 | 10,625 | 10,625 | 10,625 | 10,625 | 10,625 |
| R squared | 0.455 | 0.457 | 0.456 | 0.457 | 0.456 | 0.457 | 0.456 | 0.456 | 0.456 | 0.456 | 0.456 |

Notes: The household level controls include log per capita consumption expenditure, gender, gender of household head, average years of education in the household, ethnic groups (Akan, Krou, Mande North, Mande South, Voltaic (comparison group) and religious groups (Muslims and Christians); *** implies significant at 1%, ** implies significant at 5% and * implies significant at 10%. Estimation with robust standard errors.

Table 5.1 Estimated effects of war on years of education using propensity score matching
(Matching method: nearest neighbor)

| | Model | Observations | Treatment | Controls | ATT |
|---|---|---|---|---|---|
| M1 | Registered deaths | 10496 | 6.368 | 6.561 | -0.193* |
| M2 | Registered injury | 10249 | 6.490 | 6.590 | -0.100 |
| M3 | Displaced | 10888 | 6.425 | 6.564 | -0.139 |
| M4 | Income dropped | 10625 | 6.409 | 6.686 | -0.277** |
| M5 | Lost ownership | 10070 | 6.217 | 6.530 | -0.313 |
| M6 | Lost job | 6541 | 5.182 | 6.364 | -1.182* |
| M7 | Lost farm | 4870 | 5.392 | 5.804 | -0.412 |
| M8 | Lost livestock | 5335 | 5.589 | 5.900 | -0.311 |
| M9 | Lost assets | 7305 | 6.811 | 7.232 | -0.421 |
| M10 | Affected by the war | 10625 | 6.535 | 6.761 | -0.226** |
| M11 | Experienced violence | 10167 | 6.468 | 6.625 | -0.158 |

*** implies significant at 1%, ** implies significant at 5% and * implies significant at 10%.
(ATT: the average treatment effect on the treated)

Table 5.4 OLS Regression outcomes on Average Years of Education for individuals by gender and age groups

| | All | Girls | Boys | Aged 10-14 | Aged 15-18 | Aged 19-22 |
|---|---|---|---|---|---|---|
| Registered deaths | -0.128** | -0.012 | -0.232*** | -0.103 | -0.040 | -0.212 |
| Registered injury | -0.115* | -0.044 | -0.172** | -0.155** | -0.044 | -0.053 |
| Displaced | -0.033 | -0.044 | -0.031 | -0.085 | -0.138 | 0.203 |
| Income dropped | -0.220*** | -0.170* | -0.248*** | 0.039 | -0.100 | -0.504*** |
| Lost ownership | -0.125 | -0.034 | -0.161 | -0.202 | 0.111 | -0.225 |
| Lost job | -1.602*** | -1.347*** | -1.766*** | -0.672* | -1.491** | -2.056*** |
| Lost farm | -0.516 | -0.750** | -0.439 | -0.192 | -0.479 | -0.582 |
| Lost livestock | -0.682*** | -0.441 | -0.831** | 0.036 | -0.594 | -1.039* |
| Lost assets | -0.200 | -0.488 | 0.034 | -0.027 | 0.012 | -0.419 |
| Affected by the war | -0.058 | 0.030 | -0.134** | -0.007 | -0.003 | -0.160 |
| Experienced violence | -0.240*** | -0.081 | -0.357*** | -0.008 | -0.155 | -0.409* |

Notes: The household level controls include log per capita consumption expenditure, gender of household head, average years of education in the household, ethnic groups (Akan, Krou, Mande North, Mande South, Voltaic (comparison group) and religious groups (Muslims and Christians); *** implies significant at 1%, ** implies significant at 5% and * implies significant at 10%. Estimation with robust standard errors.

[i] For more information go to the ACLED website at http://www.prio.no/CSCW/Datasets/Armed-Conflict/Armed-Conflict-Location-and-Event-Data/

[ii] DIVA-GIS website for Cote d'Ivoire http://www.diva-gis.org/datadown

[iii] The following website http://www.acleddata.com/index.php/dynamic-maps provides conflict maps for a number of countries.